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WALTER M. DICKIE, M.D., Director

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State Office Building, 217 West First
Street MAdison 1271

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Vol. XVII, No. 30 August 20, 1938 GUY P. JONES
EDITOR

Carbon Monoxide Studies in the Industrial Hygiene Program

(Continued from last issue)

The treatment of carbon monoxide asphyxiation is based on the elimination of the gas from the body. The mechanism is the reverse of that of absorption. The gas is not burned to carbon dioxide or otherwise destroyed in the body, but is eliminated through the lungs when air free from the gas is inhaled. Fortunately, the combination of carbon monoxide with haemoglobin, while much more stable than that of oxygen and haemoglobin, is reversible, and carbon monoxide can be driven out of the blood by an excess of oxygen in the lungs. The victim should be removed at once to fresh air. As soon as the tension of carbon monoxide in the lungs is less than that in the blood, the gas begins to pass from the blood to the air in the lungs, and is given off in the exhaled air. However, this normal elimination is slow, requiring many hours to wash out all of the gas in the blood. It can be greatly accelerated by increasing the amount of oxygen in the lungs, and by increasing the rate and depth of breathing. Both of these effects are produced by the inhalation of a mixture of 93 per cent oxygen and 7 per cent carbon dioxide, which removes the carbon monoxide from the blood five or six times as fast as normal air. If breathing has stopped, artificial respiration by the Schafer method should be given. Circulation should be aided by hot applications, physical exertion avoided, and any aftereffects treated symptomatically.

More important than the treatment of carbon monoxide poisoning, is its prevention. This is based on good ventilation, avoidance as much as possible of exposure to air known to contain the gas, and the use of adequate protective equipment when it is necessary to breathe air known to contain carbon monoxide.

For continuous exposure, the concentration of carbon monoxide in the air of a workroom should never be permitted to exceed one part of the gas per 10,000 parts of air, or .01 per cent.

Good ventilation includes not only an ample supply of fresh air to the workroom, but also removal of carbon monoxide from the breathing level of workers to the outside air by adequate suction devices and exhaust ventilating systems applied to industrial operations in which this gas is generated. All gas-burning stoves and heaters should be properly vented, and the burners kept in good repair and adjustment. The keynotes of safety in the use of all industrial fuel-burning appliances, are careful design to insure complete combustion of the fuel, proper installation to prevent escape of carbon monoxide into the workroom, and periodic overhauling to detect leaks and faulty adjustments. Flexible tubing is one of the greatest sources of gas leaks. If used, it should be of an improved type, preferably of metal, and attached by solid metal connections, wherever practicable.

Garages, service stations, and repair shops, in which engine exhaust gases are generated during warming up, testing, or adjustment of motors, should be provided with a system of positive ventilation to remove or reduce the carbon monoxide to within safe limits. Automobiles should never be started or warmed up in a closed garage. The exhaust systems of motor vehicles should be inspected carefully and periodically for any defects which permit the escape of exhaust gases before reaching the exhaust pipe outlet. Drivers' compartments should be fitted with tight floor mats to exclude exhaust gas which may enter through cracks around floor boards, and openings in the dash should be closed as tightly as possible.

Various types of respiratory apparatus have been designed for the use of persons such as firemen, miners, and mine rescue workers who must at times enter atmospheres containing carbon monoxide. Of these devices, gas masks are the simplest and easiest to wear, but they protect only in comparatively low concentrations of toxic gases, and should never be used where the air contains less than 16 per cent of oxygen. Positive pressure hose masks which supply fresh air to the wearer through a hose, protect in any irrespirable atmosphere, but are cumbersome and unwieldy, and the length of hose limits the distance the wearer may go away from the source of fresh air. Self-contained oxygen breathing apparatus also furnish protection in any irrespirable atmosphere for from one-half hour to two hours, depending on the capacity of the oxygen tank, but are heavy, can be used only by trained men, and require frequent attention to be maintained in good working condition. However, they are the only safe means of protection in exploring mines and other places filled with toxic gases in high concentration.

During the past year, the Industrial Hygiene Service has received a number of requests from industrial establishments in various parts of the state for assistance in the study and control of occupational health hazards. In order to determine whether such a hazard exists in any particular work room, it is necessary to make precise quantitative measurements of the amount and distribution of the potentially dangerous subtances involved. In making such studies in plants in which carbon monoxide may be a potential health hazard, we use an instrument known as a portable carbon monoxide indicator, which oxidizes the carbon monoxide in the air to carbon dioxide by the catalytic action of a mixture of metallic oxides known as Hopcalite. The heat generated in this oxidation is converted into electrical energy and registered on an accurately calibrated millivoltmeter. Concentrations of carbon monoxide ranging from 5 to 1000 parts per million in the air sample tested, can be read directly by means of this instrument.

I would like to mention briefly several examples of carbon monoxide studies which have been made by the Industrial Hygiene Service recently. The employees of a large garage and repair shop had complained for some time of persistent headaches, weakness and nausea. At the request of the management, we made hourly carbon monoxide determinations at various points in the shop over a four-day period, and found that at several of these working places, the average concentration of carbon monoxide breathed by employees during the working day was in excess of 100 parts per million. Recommendations for improved ventilation and removal of engine exhaust gases were prepared and submitted to the shop superintendent, who is now putting them into effect. He has asked that further tests be made to determine the effectiveness of these control measures.

In a railroad tunnel three gasoline engines were used to operate compressors furnishing compressed air for drills used in repair work on the walls of the tunnel. The exhaust gases from these engines were being discharged directly into the tunnel. Several workmen had become ill, presumably due to gas. At the request of the construction company in charge of the repair work, carbon monoxide tests were made at all points in the tunnel where men were working. It was found that dangerously high concentrations of carbon monoxide were present at several of these points. On the basis of our recommendations that additional ventilation be provided a blower fan of 43,000 cubic feet per minute capacity was installed at one end of the tunnel. Subsequent tests showed that carbon monoxide concentration had been reduced to well within safe limits by the large volume of fresh air forced into the tunnel by this fan.

In cooperation with the California Highway Patrol, a state-wide survey of motor vehicles was made to study the relation of engine exhaust gas inhalation to highway traffic casualties. Determinations of carbon monoxide concentration in the drivers' compartment of 1100 vehicles, mostly trucks and buses, were made during five-minute runs on the highways in various parts of the state. In 2 per cent of these vehicles, the driver was found to be breathing amounts of carbon monoxide sufficient to cause headache, weakness, sleepiness, and impaired driving ability. In each of these potentially dangerous vehicles, the source of the trouble was traced to some defect in the exhaust system, such as a blown-out exhaust gasket, cracked manifold, loose exhaust pipe connection, or leaky muffler, which permitted the escape of exhaust gases, and their entrance into the drivers' compartment through openings in and around the cab, in many cases without the driver being aware of their presence. By means of a flexible hose attached to the carbon monoxide indicator used in making the tests, we were able to locate exhaust leaks which were not noticeable on casual inspection, and to point them out to the driver, with recommendations for necessary corrective measures. In several cases in which repairs could be made on the spot, such as tightening a loose exhaust pipe connection, further tests showed that the carbon monoxide concentration in the air breathed by the driver had been reduced well below the danger threshold by such repairs.

In conclusion, I would like to emphasize the fact that while the widespread exposure to carbon monoxide gas in industry and its high degree of toxicity make it one of our most serious occupational health hazards, its control is entirely possible. The facilities of the Industrial Hygiene Service are available to any industry which wishes definite information concerning harmful materials or conditions to which its workers may be exposed, and assistance in devising practical methods for the control of such hazards.

The success of the state industrial hygiene program depends largely on the cooperation of industry, labor, and local public health officials. To this end we earnestly invite your assistance and support.

IMPROVED SEWAGE DISPOSAL METHODS

Reviewing the last ten years in matters of sewage collection and treatment in California, the Chief of the Bureau of Sanitary Engineering states that it is apparent that the trends continue toward urbanization of the state and, with it, further approach toward universal sewer service. The number of incorporated places or sanitary districts has increased from 312 to 339. The percentage of urban population now served by public sewers is almost 94 and by treatment plants, nearly 58. The number of sewage treatment plants has increased nearly twice as fast as the incorporation of new places. There are now 237 treatment plants in 367 places having sewer systems. Population growth served by treatment works has just about kept pace with total population growth and with growth of population served by sewers, showing approximately a 30 per cent increase in the past ten years. This would seem to imply that California is just holding its own in sewage treatment. This is true in the larger cities. The smaller ones have forged far ahead and afford the most shining progress. Another ten years is certain to find the larger cities resorting to sewage treatment, where there is none at this time.

The trends have been quite distinctly toward the more common adoption of high grade or oxidation works, particularly in the form of trickling filters. Equally definite are the trends toward separate sludge digestion, the more common use of mechanized biologic processes, collection and burning of gases from sludge digestion, disinfection for odor control and for disinfection, more ornate arrangement and housing of sewage treatment works, somewhat less attention to the selection of treatment plant sites for better isolation, vastly greater realization of the value of operation and the operator, considerable increase in use of laboratory technique in plant control and various other trends perhaps not quite so noticeable. Probably the two outstanding developments of these ten years, which are felt nearly everywhere, are the growth of the California Sewage Works Association and the spurt given sewage treatment as a result of the labor relief policies of the Federal Government in one form or another.

Almost no progress has been made in new or improved methods of handling industrial wastes, other than a well marked trend to cut down losses of wastes in industries, which are principally of agricultural derivation—fruit and vegetable canneries and milk handling or processing.

Report on Sewerage and Sewage Treatment in California 1928 and 1938

	1928 Est.	1930 Census	1938 Est. (Jan. 1, 1938)
1. Total population in California	5,288,700	5,677,251	6,576,000
1a. No of cities, towns and sanitary districts	312	------	339
2. Population — urban and sanitary districts	3,956,000	------	5,193,000
2a. No. of places served by sewers	325	------	367
3. Population served by sewers	3,820,000	------	4,853,000
3a. No. of treatment plants	182	------	237
4. Population actually served by treatment works	2,283,000	------	2,973,000
5. Per cent State population still needing sewage treatment	43%±	------	40%±
6. No. of industrial waste treatment plants	No data	------	No data

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PREVENTION OF SMALLPOX

Because of the increased prevalence of smallpox in California the attention of health officers is drawn to the absolute need for vaccinating the nonimmunized in every community. While the smallpox situation is by no means alarming, wherever the disease appears effective control measures are established. It is, nevertheless, important that eternal vigilance be maintained lest the disease flare up in some community where vaccination may have been neglected. Most health officers are active in conducting procedures against smallpox in routine fashion.

MORBIDITY

Complete Reports for Following Diseases for Week Ending August 13, 1938

Chickenpox

35 cases: Alameda County 4, Oakland 3, Concord 1, Richmond 2, Fresno County 1, Los Angeles County 5, Avalon 1, Los Angeles 2, Redondo 3, Santa Monica 1, Bell 1, Mono County 1, Santa Ana 1, Ontario 1, San Bernardino 2, San Francisco 2, Burlingame 2, Palo Alto 1, Oxnard 1.

Diphtheria

10 cases: Los Angeles County 3, Los Angeles 3, Soledad 1, San Luis Obispo 1, Santa Cruz County 1, Tulare County 1.

German Measles

16 cases: Alameda County 1, Berkeley 1, Livermore 1, Los Angeles County 3, Los Angeles 3, Pasadena 1, Fullerton 1, San Francisco 2, Stockton 1, Tuolumne County 1, Ventura County 1.

Influenza

5 cases: La Verne 1, Los Angeles 2, Carmel 1, Orange County 1.

Malaria

24 cases: Butte County 1, San Bernardino 1, Stockton 1, Sutter County 1, Yolo County 18, Yuba County 1, Marysville 1.

Measles

143 cases: Alameda County 3, Berkeley 1, Oakland 17, Butte County 2, Fresno County 2, Fresno 1, Kern County 1, Los Angeles County 13, Alhambra 1, Claremont 2, Culver City 1, Glendale 2, Inglewood 1, Long Beach 6, Los Angeles 14, Pasadena 5, San Fernando 1, Santa Monica 1, Maywood 2, Yosemite National Park 1, Carmel 1, Orange County 5, Anaheim 1, Brea 1, Santa Ana 1, Sacramento County 1, Sacramento 3, Ontario 4, San Diego County 2, National City 1, San Diego 23, San Francisco 3, Stockton 4, Paso Robles 1, San Luis Obispo 4, Daly City 1, Redwood City 1, Santa Barbara 1, Santa Clara County 2, San Jose 3, Ventura County 2, California 1.*

Mumps

134 cases: Alameda County 4, Alameda 2, Berkeley 12, Oakland 16, Chico 1, Contra Costa County 1, Fresno County 3, Fresno 8, Kern County 7, Los Angeles County 8, Inglewood 1, Long Beach 1, Los Angeles 8, San Fernando 1, Sierra Madre 1, Madera County 2, Madera 1, Sausalito 1, Pacific Grove 4, Orange 1, Tustin 2, Balboa 2, Sacramento 10, San Diego County 1, Chula Vista 1, San Diego 8, San Francisco 13, San Joaquin County 2, San Luis Obispo County 3, Lompoc 1, San Jose 4, Sunnyvale 1, Santa Cruz 1, Healdsburg 1, Yolo County 1.

Pneumonia (Lobar)

33 cases: Oakland 1, Martinez 1, Los Angeles 17, Maywood 1, Sacramento County 1, Sacramento 2, San Bernardino County 1, San Francisco 9.

Scarlet Fever

49 cases: Oakland 1, Richmond 1, Fresno County 1, El Centro 1, Kern County 2, Los Angeles County 11, Glendale 1, Los Angeles 15, Santa Monica 1, Torrance 1, Merced County 1, Salinas 1, Placentia 1, Riverside County 1, Riverside 2, National City 1, San Diego 1, San Francisco 3, Stockton 1, Tulare County 1, Ojai 1.

Smallpox

4 cases: Los Angeles County 1, Sacramento County 1, Stockton 1, Visalia 1.

Typhoid Fever

8 cases: Contra Costa County 1, Reedley 1, Brawley 1, Los Angeles County 1, Los Angeles 1, Riverside County 1, Woodland 2.

Whooping Cough

181 cases: Alameda County 9, Alameda 3, Berkeley 4, Oakland 10, San Leandro 1, Butte County 3, Contra Costa County 1, Concord 1, Kingsburg 2, Kern County 1, Lake County 1, Los Angeles County 25, Inglewood 1, Los Angeles 32, Montebello 1, Pasadena 1, Pomona 1, San Fernando 1, South Gate 1, Bell 2, Merced County 2, Monterey 2, Pacific Grove 1, Orange County 4, Santa Ana 4, La Habra 2, Laguna Beach 1, Riverside 1, Sacramento 11, San Bernardino County 2, El Cajon 6, National City 1, San Diego 2, San Francisco 14, San Joaquin County 3, Lodi 4. Stockton 3, Palo Alto 1, San Jose 3, Santa Cruz 2, Ventura County 5, Oxnard 1, Santa Paula 5.

Meningitis (Epidemic)

6 cases: Los Angeles County 1, Long Beach 1, San Francisco 1, Tulare County 2, Visalia 1.

Dysentery (Amoebic)

4 cases: Pasadena 2, Orange County 1, Ventura County 1.

Dysentery (Bacillary)

27 cases: Los Angeles County 1, San Francisco 3, Sonoma County 20, California 3.*

Pellagra

One case: Los Angeles.

Poliomyelitis

6 cases: Kern County 1, Lake County 1, Pomona 1, Riverside County 1, Tehama County 1, Visalia 1.

Tetanus

One case: Kern County.

Trachoma

2 cases: San Francisco 1, San Mateo County 1.

Encephalitis (Epidemic)

2 cases: Butte County 1, Tulare County 1.

Paratyphoid Fever

One case: Sonoma County.

Trichinosis

2 cases: Los Angeles County 1, Sausalito 1.

Typhus Fever

One case: Chula Vista.

Food Poisoning

64 cases: Kern County 3, San Bernardino County 61.

Undulant Fever

2 cases: Santa Cruz 1, Ventura 1.

Coccidioidal Granuloma

One case: Tulare County.

Septic Sore Throat

One case: Tulare County.

Relapsing Fever

2 cases: California.*

Rabies (Animal)

19 cases: Kern County 1, Los Angeles County 5, Los Angeles 11, San Joaquin County 1, Stockton 1.

No enterprise in the range of human experience can rank with learning. By it alone man rises above dumb creatures. If, therefore, we have received nothing else so good as the mind, what should be more worth cultivating? No quest of gold or worldly power has in the long run ever brought like gratification. No other adventure is to be compared with it. Through it civilization and all man's higher achievements have been won.—Leon J. Richardson.

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* Cases charged to "California" represent patients ill before entering the state or those who contracted their illness traveling about the state throughout the incubation period of the disease. These cases are not chargeable to any one locality.

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